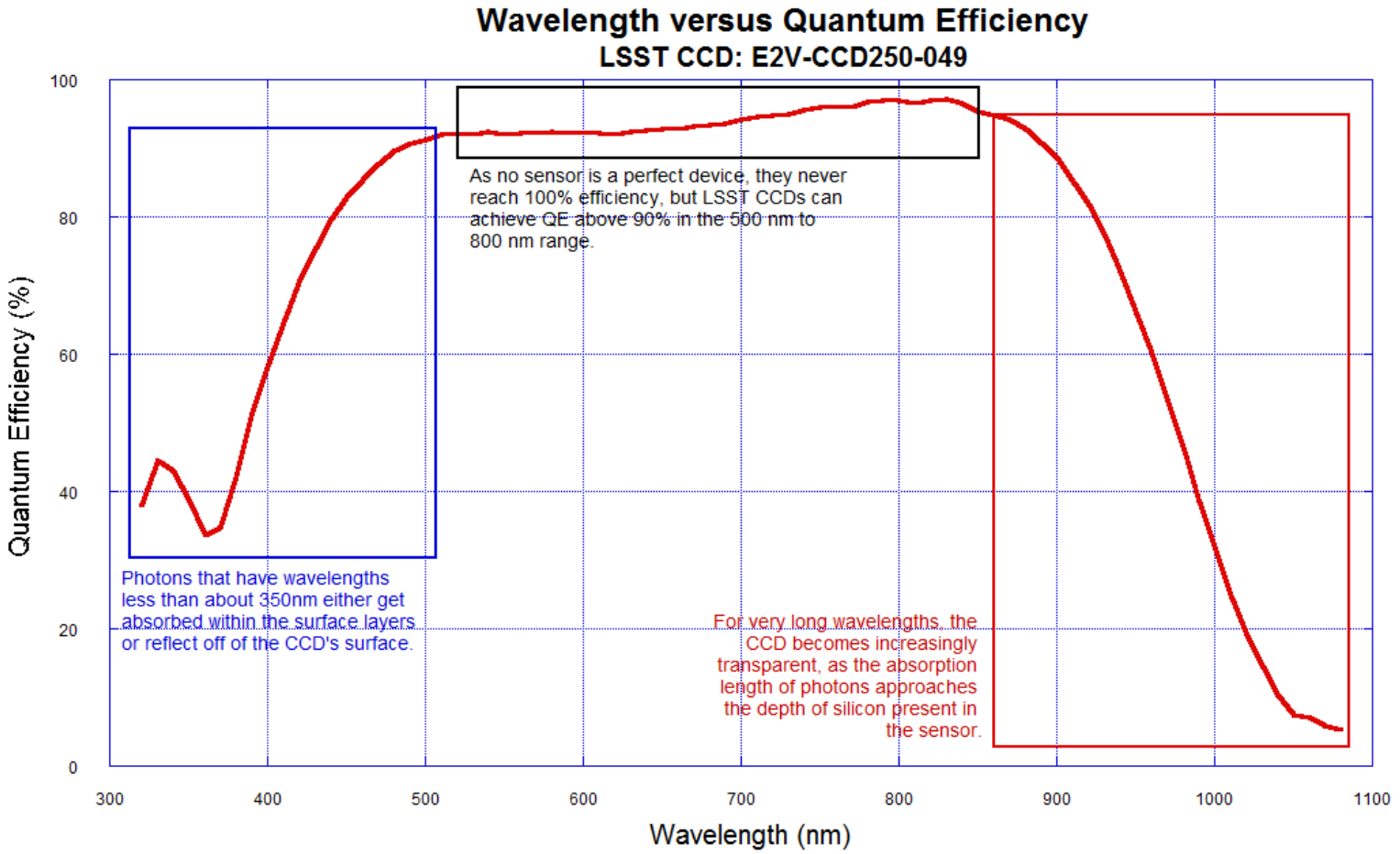
TS3 Uncertainty

01-02-2016

Quantum Efficiency

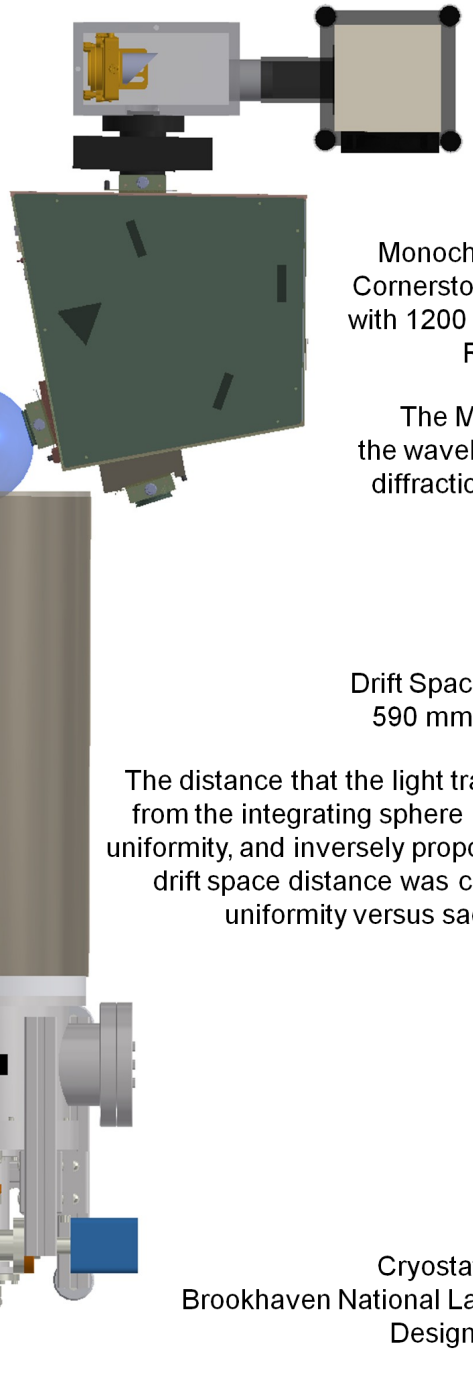
The composition of a CCD is predominantly silicon, and therefore the sensitivity of the sensor to different wavelengths of light is dependent on silicon's inherent properties.



TS3

Off-Axis Parabolic Mirror

Light Source:
300 W Xe Arc Lamp



Shutter and Filter Wheel:
305 nm and 590 nm Longwave Pass Cut-On Filters. (Black Rectangles)

The filters help reduce stray light and avoid second-order effects from the monochromator

Monochromator with Grating:
Cornerstone 260 Monochromator with 1200 lines/mm, 200-1400 nm Range Grating.

The Monochromator uses the wavelength dispersion of the diffraction grating to filter light.

Integrating Sphere:
6 in diameter Labsphere

Since the sphere's surface illuminates isotropically, and the light is reflected multiple times, the light loses its spatial information and emerges as a uniform source (Lambertian reflectance).

Drift Space:
590 mm

The distance that the light travels after emerging from the integrating sphere is proportional to its uniformity, and inversely proportional to its flux. The drift space distance was chosen to optimize uniformity versus sacrificed flux.

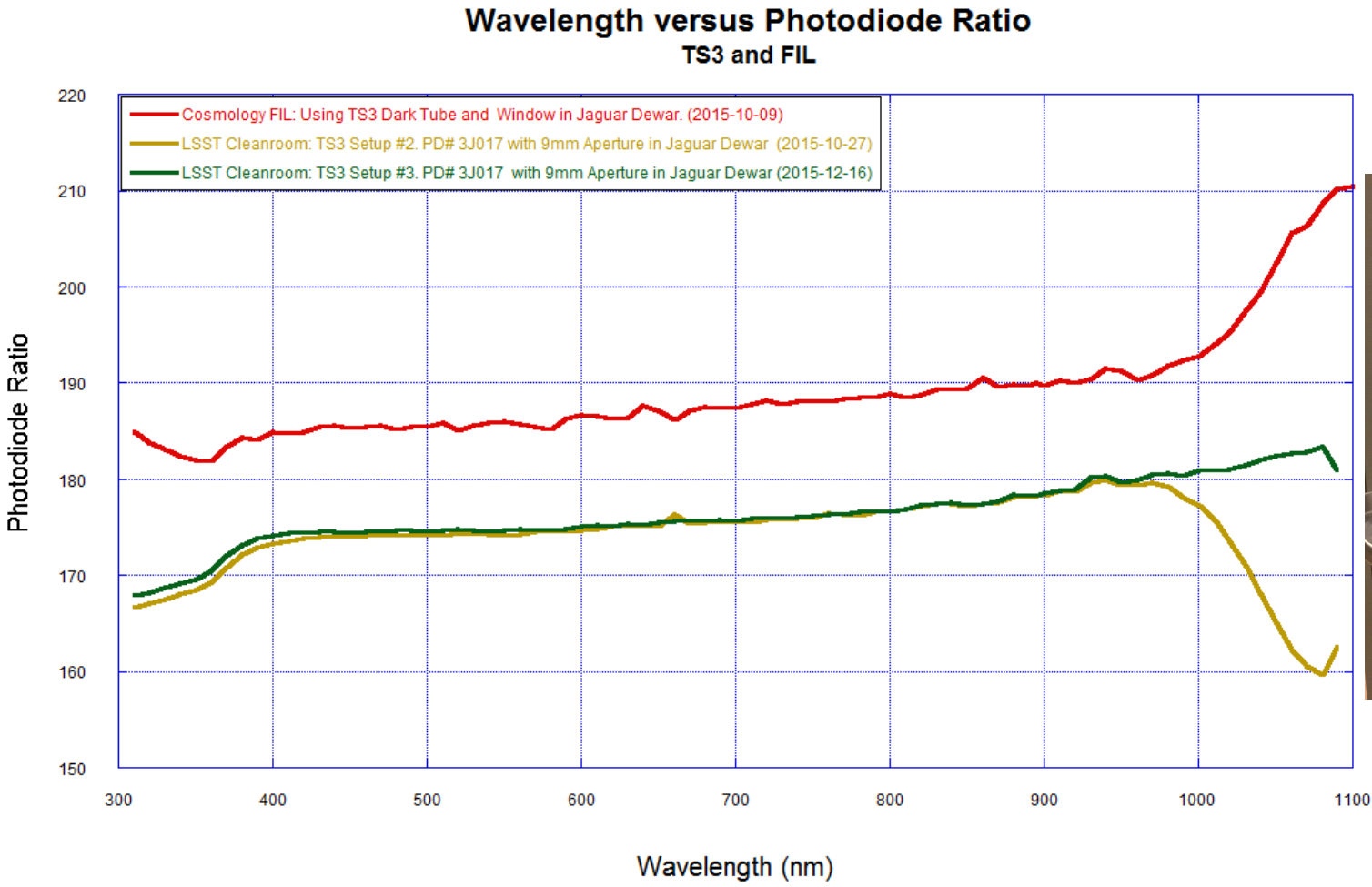
Cryostat:
Brookhaven National Laboratory Custom Design

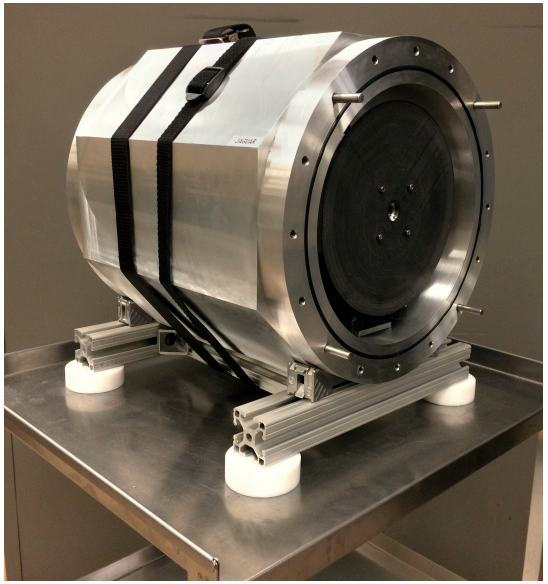
Inside the Cryostat, the CCD is in vacuum and kept at its operating temperature of -95ºC

Uncertainty Measurements

- Repeatability
- Reproducibility
- Instrument Bias

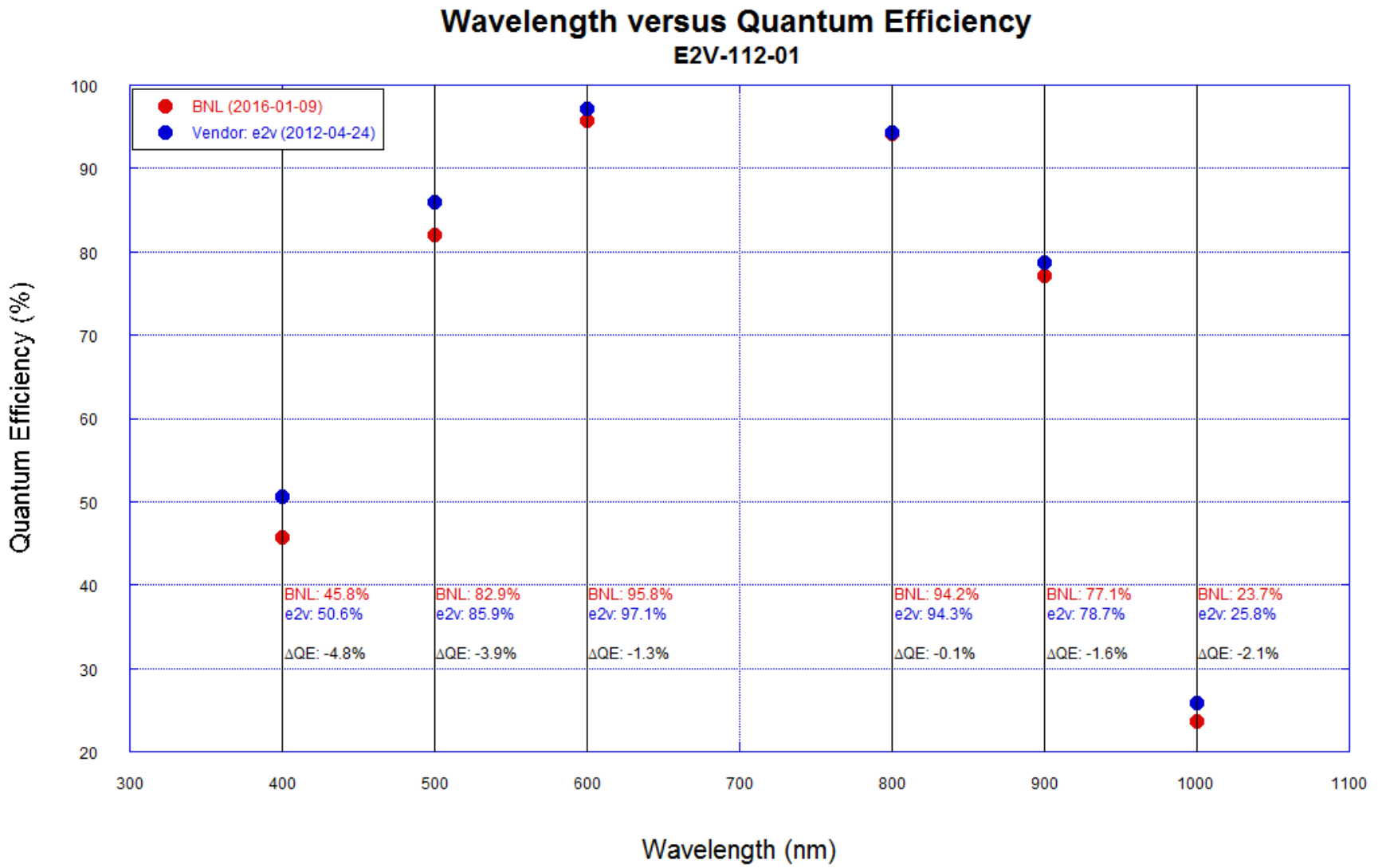
Repeatability





Photodiode ratio measurements in cleanroom agree; FIL measurement is under investigation.

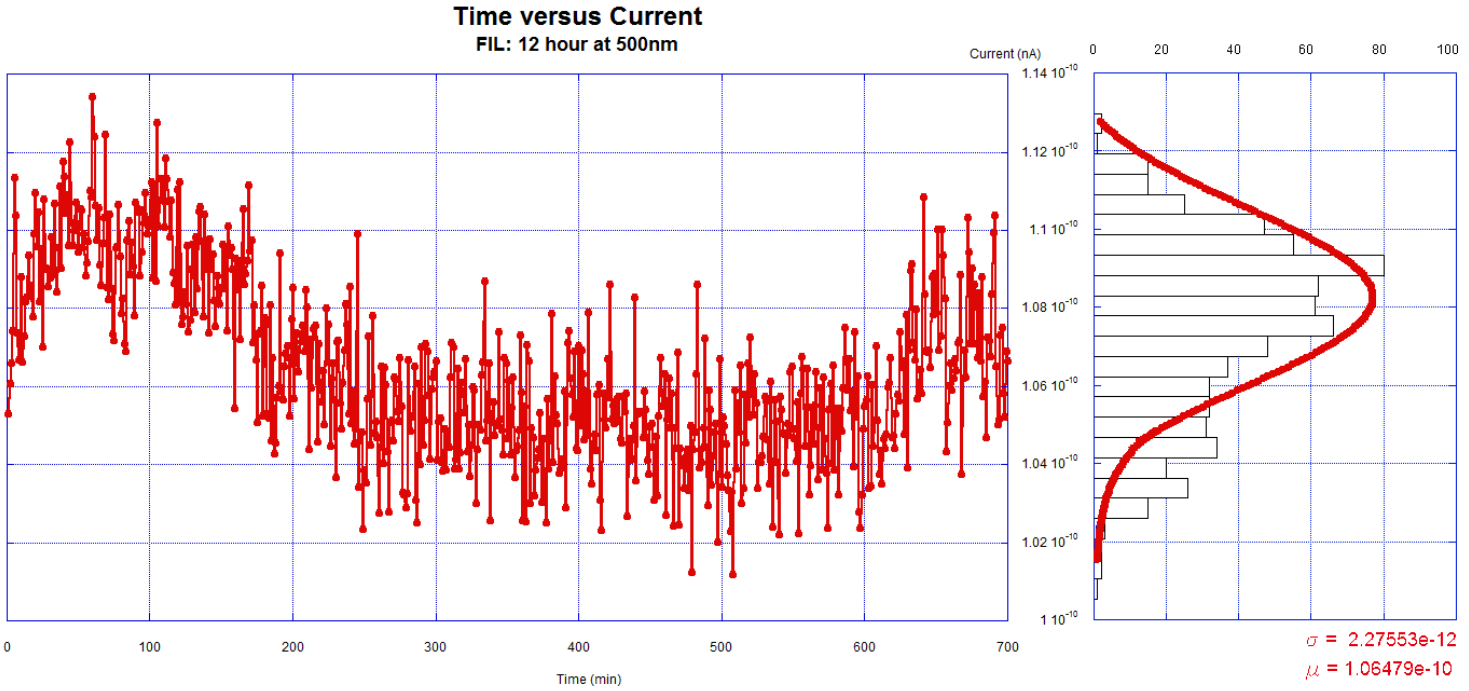
Reproducibility

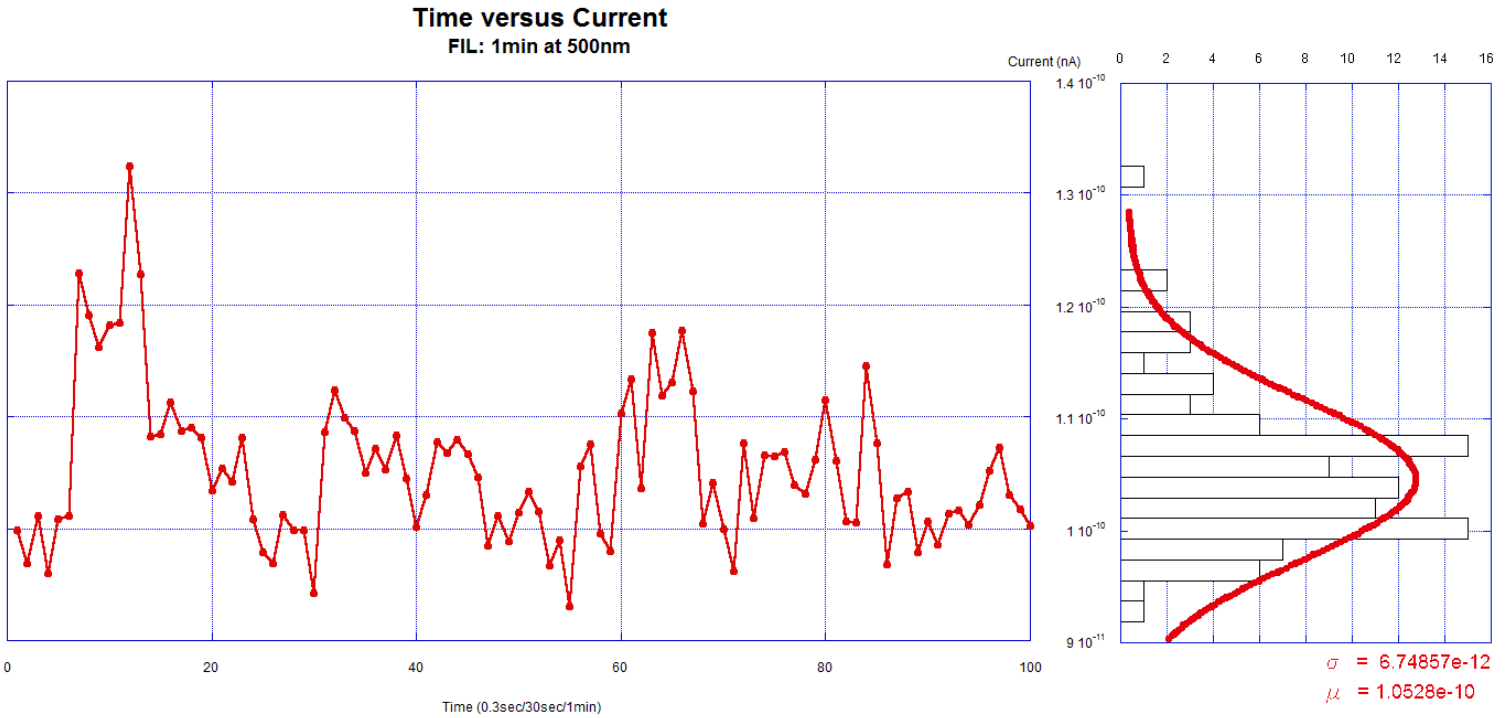


Temp: -95ºC

Gain: fe55 method

Instrument Bias: Lamp Drift





To Do

Repeatability:

- Measurements taken over a short time to capture the precision of the gauges.
- Measurements taken over days.
- Measurements taken over runs separated by months.

Reproducibility:

- TS3-2 and TS3-3 compared to each other.
- TS3-2 and TS3-3 compared to FIL stand.
- TS3-2 and TS3-3 compared to Vendor measurements (Absolute).

Instrument Bias:

Lamp and Housing, Off-axis parabolic mirror, Iris shutter, Filter wheel and filters, Integrating sphere, Dark space with baffles, Glass Dewar window.

Stray Light

Measurement method 1:

Dark cleanroom versus normal lighting.

Measurement method 2:

1) Measure the flux with and without a glass plate in the beam that blocks all radiation below 320 nm.

2) Compare the signal at 210 nm without the glass to the signal at 210 nm with the glass.

3) When the entire desired signal is blocked by insertion of a glass plate, what remains is scattering radiation.

4) This comparison is based on a taxing but real measurement scenario. The test is similar in principal to ASTM E387, Standard Test Method for Estimating Stray Radiant Power Ratio of Dispersive Spectrophotometers.

Measurement method 3:

Double Monochromators: The intensity of the light of other colors in the exit beam is referred to as the stray light level and is the most critical specification of a monochromator. The Double-Mono helps quantify this.